Craving: A research update:
Editorial to a Special Issue

David J. Kavanagh
Institute of Health and Biomedical Innovation and School of Psychology &
Counselling Queensland University of Technology

Jason P. Connor

Discipline of Psychiatry, The University of Queensland
and
Centre for Youth Substance Abuse Research, The University of Queensland

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Craving has long been associated with addictive disorders. It has received much attention over the last two decades, partly through the advent of pharmacotherapies that attempt to address it (Jonson, 2008; Yahyavi-Firouz-Abadi & See, 2009). More recently, craving for substances has attained increased prominence, with the inclusion of "Craving or a strong desire or urge" in the draft of DSM-5 (APA, 2012). Studies generally support craving as occurring on a single diagnostic dimension alongside existing dependence criteria (Hasin, et al., 2012; Keyes, et al., 2011). Some (e.g. Keyes, et al., 2011) demonstrate that the addition of craving to DSM-IV alcohol abuse and alcohol dependence criteria contributes novel variance in predicting severity, and improves discrimination above that offered by existing DSM-IV criteria. Within the current volume, the paper by Agrawal et al. confirms that craving strongly loads on a single dimension that also incorporates DSM-IV alcohol dependence criteria. Craving was a relatively severe symptom: It was least often endorsed, and did not exceed 50% endorsement until 6 of the remaining 7 criteria were present.

These observations attest to craving being a core feature of substance use disorders, and suggest it is timely for it to have additional theoretical and empirical attention. The current issue fills that gap, and suggests ways our understanding can progress further. In addition to confirming the importance of craving for diagnosis, the paper of *Agrawal et al.* identifies a number of key single nucleotide polymorphisms (SNPs) that are associated with dependent craving, but are not linked to non-craving dependence. This intriguing finding raises the possibility of unique genetic determinants of craving, which in turn may lead to improved understanding of the processes underpinning related individual differences, and perhaps new targeted approaches to pharmacotherapy.

We have included two important pharmacological studies in the issue. Goudriaan, Veltman, van den Brink and Schmaal demonstrate the impact of modafinil—a cognitive

enhancer—on brain activation during exposure to cocaine cues. Repeated administrations of modafinil have previously demonstrated an impact on both craving and use of cocaine in dependent individuals (e.g. Anderson et al., 2009). While a single dose of modafinil did not differentially affect subjective craving, it did reduce activation of the reward-related ventral tegmental area and increased activation of areas linked to cognitive control (the anterior cingulate cortex and putamen). The latter activation correlated positively with decreased craving, suggesting that treatment effects may be mediated by improved cognitive control.

The second paper, by Yoon and colleagues, examined whether repeated administration of D-cycloserine improved responses to psychological treatment of tobacco smoking by cocaine users. D-cycloserine appears to assist with extinction of fear responses (Norberg, Krustal & Tolin, 2008), although its effects on cue exposure therapy for substance use are less well established (Kamboj, Joye et al., 2012, Kamboj, Massey-Chase et al., 2012; Watson et al., 2011). Consistent with most other recent research, Yoon et al. did not find a differential effect of D-cycloserine on cigarette smoking or related craving after 2 sessions of cue exposure and 12 daily sessions of cognitive-behavior therapy. The drug may have greater effects on the extinction of aversive responses than of appetitive ones in humans, although we are at early stages of investigation in this area.

Negative moods and stress reactions are known to increase craving (e.g. Maude-Griffin & Tiffany, 1996), and two papers in this issue discuss aspects of this effect. Perkins, Karelitz, Giedgowd and Conklin show that increases in cigarette craving after exposure to a mood manipulation are more pronounced in women. It remains to be seen whether these results are generalizable, and if they reflect sex differences in associated neural or other biological processes, or occur because of differential experience in the use of tobacco or other substances to relieve distress. Glöckner-Rist, Lémenager, Mann and the PREDICT

Study Research Group also examined sex differences—this time relating to degree of temptation to drink in specific situations. While men were more likely to report higher temptations when alcohol use appeared rewarding, effects of trait anxiety and recent stress on relief-related temptations were not modified by gender. However, those results were based on a cross-sectional assessment of the temptation value of situations, rather than reports of actual craving.

Substance-related craving often occurs in the context of other, conflicting motivations (e.g. to control or abstain from consumption). A paper in this volume by Wilson, Creswell, Sayette and Fiez highlights differences in neural activation to smoking-related cues, when participants have high vs. low levels of ambivalence about smoking. Greater ambivalence was associated with less activation of brain areas related to reward, motivation and attention, which suggested a reduced impact of the cue exposure rather than greater conflict.

Supporting the idea that intense craving tends to involve sensory imagery (Kavanagh, Andrade & May, 2005), craving can be reduced by concurrent tasks involving similar sensory domains, especially if they also require limited working memory capacity or significant involvement of the central executive (Andrade, May, & Kavanagh, 2012; Andrade, Pears, May, & Kavanagh, 2012). In this issue, Kemps and Tiggeman continue this line of research, by showing that an unfamiliar smell reduces craving for foods.

Concurrent tasks are not the only way to address craving. Meditation mindfulness induces emotional distancing from thoughts, and empowers people to notice thoughts, but not necessarily to process them further. It is therefore a potential way to halt elaboration of desire-related thoughts and of related metacognitions (such as worry about loss of control). In a cross-sectional study of people in residential treatment for substance dependence,

Garland and Roberts-Lewis examined relationships between trauma history, PTSD symptoms, dispositional mindfulness, thought suppression and craving. More severe PTSD symptoms and thought suppression were associated with greater craving, and increased mindfulness with less craving. However, in a multivariate path analysis, only dispositional mindfulness offered a unique prediction.

In a secondary analysis of a randomised controlled trial on the impact of mindfulness-based relapse prevention on substance use and related craving, Witkiewitz, Bowen, Douglas and Hsu examined mechanisms by which mindfulness reduced craving, and found that changes in awareness, acceptance and nonjudgment mediated these effects. The results are consistent with the idea that mindfulness frees people from preoccupation with craving by helping them to notice and accept alcohol-related thoughts, and then to allow their attention to move on. The papers on mindfulness strike a chord with others in this issue: Commitment to not use substances does not necessitate conflict and suppression of craving (which is known to be counterproductive—Palfai, Monti, Colby, & Rohsenow, 1997). A mindful approach can reduce the affective power of the thought, or (as in the studies of Wilson et al. and Goudriaan et al.) thoughts about the substance can become less attractive and salient (either because of effects of a medication, or because the substance gathers negative associations).

Existing alcohol craving measures are then reviewed by Kavanagh et al. in relation to conceptual and psychometric standards. It finds that most purported measures of craving are confounded with other cognitive or motivational constructs, or even with drinking and its functional impact. Kavanagh et al. argue that this confounding is retarding advances in understanding the phenomenon and its determinants, and is inflating predictions of drinking. Retrospective ratings of average craving over extended periods give respondents a

task that is prone to bias, and is insufficiently sensitive to the high degree of variability in the intensity and frequency of craving over time: This feature of some measures inhibits their predictive utility. Where retrospective measures are used, the paper recommends a focus on the frequency or duration of craving cognitions, on peak craving, or on its functional impact. However, it supports repeated administrations of daily ratings of peak craving and urges as offering a more optimal solution.

Among the better performing measures identified in the review by Kavanagh et al. was the Obsessive subscale of the Obsessive-Compulsive Drinking Scale (OCDS; Anton, Moak & Latham, 1995), which does focus on frequency, duration and impact of craving cognitions. In the paper by Connolly et al., the predictive utility of Anton et al.'s (1995) Obsessive subscale is assessed in a treated sample of people with comorbid depression and alcohol misuse. A Baseline administration of the subscale significantly predicted weekly consumption at 18 weeks, and alcohol binges at 18 weeks and 12 months. These predictions remained after statistical control for the relevant Baseline dinking variable, providing additional support for this measure of craving.

As with any research on addiction, research on craving carries potential ethical risks. The paper by Carter and Hall reviews issues of informed consent, privacy, confidentiality and ensuring minimal harm and maximum benefit, as they relate to craving. For example, the authors highlight ethically sensitive research designs where substances are offered to participants immediately after consent is given, and note potential harms from emerging pharmacological, surgical and psychological interventions. Consideration of these issues also raises empirical questions, such as how rational evaluations of risks and benefits may best be promoted, and whether existing monitoring and reporting of negative impacts of psychological interventions are sufficient.

At times over the last decades, the role of craving may have been overstated. It is not the sole determinant of relapse to substance use, and there clearly are individual differences in the strength of craving and its strength as a determinant. However, nor does it seem epiphenomenal. While there has been extensive research on craving, there has also been confusion on its precise definition, and on whether variants of the phenomenon should be more clearly distinguished (e.g. urge vs. strong desire; reward vs. relief). There is still much that requires further empirical attention: the relative influence of frequency, duration and intensity; the extent craving impacts on productivity and other functioning; the bases of individual differences; and refinement of both assessments and interventions. The current set of papers offer an optimistic view of future prospects, suggesting that coming decades are likely to offer a significant leap forward in our understanding of this important phenomenon and ways it can be addressed.

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